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To cite this article: Tian Tian, Duolao Wang, Christiana Papamichael, Zhang Yan, Sang Guoyao, Zhang Zhanlin, Yeledan Mahan, Tuo Xiaoqing, Gong Zheng & Dai Jianghong (2018): HPV vaccination acceptability among men who have sex with men in Urumqi, China, Human Vaccines & Immunotherapeutics, DOI: [10.1080/21645515.2018.1520591](https://doi.org/10.1080/21645515.2018.1520591)

To link to this article: <https://doi.org/10.1080/21645515.2018.1520591>



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Accepted author version posted online: 19 Sep 2018.
Published online: 25 Sep 2018.



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RESEARCH PAPER



HPV vaccination acceptability among men who have sex with men in Urumqi, China

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ABSTRACT

Background: Human papillomavirus (HPV) infection is common among men who have sex with men (MSM), especially among Human Immunodeficiency Virus (HIV)-infected MSM. The prevalence of HPV among MSM, accounts for the higher incidence of HPV-related cancer observed in this population. It is well known that targeted HPV vaccination is an effective way to prevent HPV infection; an intervention which could be beneficial for a high-risk group such as MSM. The current study aimed to assess the attitudes towards and acceptability of the HPV vaccine among MSM in Urumqi, China.

Methods: A total of 253 HIV-uninfected and 205 HIV-infected MSM (in Urumqi, China) participated in the current cross-sectional study. Information on HPV-related knowledge, willingness to be vaccinated as well as demographic data were collected through a self-administered survey. A logistic regression model was applied to determine the predictors of HPV vaccine acceptability among the population.

Results: The survey results indicated that only 218 (47.6%) of MSM questioned were aware of the term HPV, nevertheless, once awareness was established the prevalence of acceptability of free HPV vaccine was recorded at 96.7% of the total MSM sample. However, HIV-uninfected and HIV-infected MSM demonstrated significantly different attitudes in regard to their acceptability of free HPV vaccination (94.9% vs. 99.0%, $p < 0.001$) as well as their willingness to pay for the HPV vaccination (64.8% vs. 80.5%, $p < 0.001$), with the HIV-infected group being significantly more receptive towards HPV immunization. A multivariate logistic regression analysis indicated that local residency, employment status, hepatitis B vaccination status, previous awareness of HPV and HIV status were independent predictors of the participants' willingness to pay for HPV vaccination.

Conclusions: Participants in the current study demonstrated poor knowledge of HPV but the majority of MSM were willing to accept HPV vaccine after consultation; with HIV-infected MSM displaying higher acceptability towards a potential HPV vaccination than HIV-uninfected MSM. MSM who were previously aware of HPV were more likely to be willing to pay for HPV vaccine.

ARTICLE HISTORY

Received 5 May 2018
Revised 15 August 2018
Accepted 1 September 2018

KEYWORDS

MSM; HPV vaccine; HIV

Background

The human papillomavirus (HPV) is the most common sexually transmitted infectious agent worldwide, with more than 200 types of HPV currently identified and around 40 of these types infecting the squamous epithelium of the genital tract including the anus, cervix, vulva and vagina.¹ Previous studies showed that HPV infections are common among men who have sex with men (MSM), especially among HIV-infected MSM.^{2,3} Moreover, MSM show a particularly high prevalence of HPV in the anal canal and with many developing lesions in the area more frequently than any other population.⁴ Research suggests that the higher prevalence of HPV among MSM compared to men who do not have sex with men accounts for the 20 times higher incidence of HPV-related anal cancer in the MSM population.⁵ More particularly previous studies amongst sexually active MSM in China found that 33.8–62.8% had anal HPV.^{6–9} In addition, the greater prevalence of HPV-related condyloma or as more commonly known genital warts, in MSM than for men who do not have sex with men often results to a greater physical and mental

burden.¹⁰ It has been identified that the high-risk HPV types 16 and 18 cause the majority of HPV-associated cancers whereas the low-risk HPV types 6 and 11 causes 90% of anogenital warts and the most cases of recurrent respiratory papillomatosis.^{6,11,12}

The 2017 World Health Organization position paper on HPV vaccines recommended three HPV vaccines: 2v-HPV vaccine (Cervarix® prevents infection with HPV types 16 and 18), 4v-HPV vaccine (Gardasil® prevents infection with HPV types 6, 11, 16 and 18), 9v-HPV vaccine (Gardasil® 9 prevents infection with HPV types 6, 11, 16, 18, 31, 33, 45, 52, and 58).¹³ The efficacy of all three HPV vaccines has been verified by several clinical trials.^{14–16} By 31st March 2017, 71 countries (37%) globally (including China) had introduced HPV vaccination in their national immunization programs for girls whereas only 11 countries (6%) included boys in their HPV immunization schemes.¹³ It is believed that China is likely to introduce existing HPV vaccines for men in the near future.¹⁷ Surveillance data from the Australian national 4v-HPV vaccination program indicated that the significant decline (82%) in diagnoses of

genital warts in young unvaccinated men who do not have sex with men could be attributed to herd immunity conferred by the high vaccination rate of females of the same age groups, nevertheless, the authors discuss that such an indirect protection is unlikely to benefit MSM.¹⁸ Furthermore, cost-effectiveness modelling analysis has affirmed that HPV vaccination of MSM as a beneficial program in preventing genital warts and anal cancer in this high-risk population,¹⁹ with the advantage of vaccination being particularly evident in HIV-infected MSM.

In spite of efforts in recent years to raise HPV awareness, those groups most at risk appear to remain unaware of HPV and uncertain of the associated risks of a HPV infection, with the phenomenon appearing more severe in HIV-infected MSM.²⁰ The benefits of HPV vaccination in MSM, especially those who are HIV-infected, have been extensively validated and reported, however, studies on HPV knowledge and the willingness to accept HPV vaccination among this high-risk population have produced inconsistent results.^{21–23} Most studies concluded that MSM have poor knowledge of HPV infection and vaccination whilst on the other hand enhanced HPV awareness and one's higher education level are factors positively influencing HPV vaccination acceptability. Studies on HPV knowledge and vaccination willingness for HIV-infected MSM are rare. Some studies investigated the participants' willingness to receive HPV vaccination mentioned the hypothesis of a certain vaccine effectiveness and/or vaccine costs the market price,²⁴ however, others did not involve the price of HPV vaccine.^{25,26} To develop a practical vaccination program for MSM, it is crucial to understand the extent of awareness of and acceptability towards HPV vaccine at a localised level. This study aimed to investigate the differences in awareness/knowledge of and acceptability towards HPV vaccination among HIV-uninfected and HIV-infected MSM in Urumqi, China. Moreover, taking into account that it is not currently possible to provide HPV vaccination in China free of charge, it is particularly important to investigate the willingness of MSM to pay for HPV vaccine.

Results

Characteristics of study participants

The demographic characteristics and sexual behaviors of the study participants are summarized in Tables 1 and 2 respectively. Of the total 458 MSM recruited, 218 (47.6%) were aged 30–39 years, 347 (75.8%) were local residents, 355 (77.5%) were of Han ethnicity and 372 (81.2%) received education at University and higher. Regarding sexual behaviors, a subset of participants (29 participants, 6.3%) reported engaging in high-risk behaviors such as never using condom during sex with other men and experiencing commercial sex in the past six months (18 participants, 3.9%). Furthermore, 65 individuals (14.2%) reported having sex with women in the past year, 42 (9.2%) reported never having voluntary HIV counseling and testing before, 256 (55.9%) were not circumcised and 45 (9.8%) reported having had a STDs in the past year.

Table 1. Demographic characteristics among 458 MSM in Urumqi, China.

Demographic Characteristics	HIV(-) n (%)	HIV(+) n (%)	P value	ALL n (%)
Age group (years)			0.002	
≤ 29	103(40.7)	51(24.9)		154(33.6)
30–39	108(42.7)	110(53.7)		218(47.6)
≥ 40	42(16.6)	44(21.4)		86(18.8)
Local residency*			0.143	
Yes	185(73.1)	162(79.0)		347(75.8)
No	68(26.9)	43(21.0)		111(24.2)
Ethnic group			0.636	
Han	194(76.7)	161(78.5)		355(77.5)
Others	59(23.3)	44(21.5)		103(22.5)
Level of education			0.011	
High school and lower	37(14.6)	49(23.9)		86(18.8)
University and higher	216(85.4)	156(76.1)		372(81.2)
Employment status			0.985	
Employed	222(87.7)	180(87.8)		402(87.8)
Not employed	31(12.3)	25(12.2)		56(12.2)
Current marital status			0.001	
Single	161(63.6)	157(76.6)		318(69.4)
Married	63(24.9)	22(10.7)		85(18.6)
Divorced/widowed	29(11.5)	26(12.7)		55(12)
Income (RMB)			0.130	
≤ 1000	17(6.7)	16(7.8)		33(7.2)
1001–5000	171(67.6)	130(63.4)		301(65.7)
5001–10,000	60(23.7)	59(28.8)		119(26.0)
≥ 10,001	5(2.0)	0(0.0)		5(1.1)
Smoking status			0.213	
Non-smokers	36(14.2)	38(18.5)		74(16.2)
Previous and current smokers	217(85.8)	167(81.5)		384(83.8)
Alcohol consumption			0.000	
No	5(2.0)	32(15.6)		37(8.1)
Yes	248(98.0)	173(84.4)		421(91.9)

Knowledge of HPV infection

The extend of overall awareness and good knowledge of HPV and HPV infection among the recruited MSM population is summarized in Table 3. Almost half of the participating MSM (218, 47.6%) reported having heard of HPV before and among those, of the participants who demonstrated awareness of HPV, the majority (213, 97.7%) recognized that males could be affected by HPV. Whilst the majority (214, 98.2%) of MSM who showed awareness of HPV knew that HPV is sexually transmitted, fewer (148, 67.9%) recognized that HPV is transmitted through skin-to-skin contact. More tellingly, although awareness that HPV infection can cause cancer was high (179, 82.1%) a smaller subset of participants (88, 40.4%) were aware that HPV is a virus which can cause genital warts.

HPV vaccination acceptability

Results of the population's intention to receive HPV vaccination and at what cost if they had to pay for it are displayed in Table 4. The prevalence of acceptability of free HPV vaccination was high (443 out of 458, 96.7%), whereas, only 329 (71.8%) reported willingness to pay for HPV vaccine. It is important to note that there were significant differences between HIV-uninfected and HIV-infected MSM in regard to the acceptability of a free HPV vaccine (94.9% vs. 99.0%, $p < 0.001$) and the willingness to pay for HPV vaccine (64.8% vs. 80.5%, $p < 0.001$). Although HIV-infect MSM were more likely to pay for a HV vaccine, there was no difference in the amount that the two groups (i.e. HIV-uninfected and HIV-infected MSM) were willing to pay for the HPV vaccine.

Table 2. Sexual behaviors among 458 MSM in Urumqi, China.

Sexual behaviors	HIV (-)	HIV(+)	P value	ALL
	n (%)/median (IQR)	n (%)/median (IQR)		n (%)/median (IQR)
Age at first anal intercourse (year)	20(18–21)	19(17–21)	0.030	19(17–21)
Self-reported sexual orientation			0.002	
Gay	233(92.1)	202(98.5)		435(95.0)
Bisexual/heterosexual*	20(7.9)	3(1.5)		23(5.0)
Gender of sex partner			0.002	
With men only	140(55.3)	143(69.8)		283(61.8)
Both men and women	113(44.7)	62(30.2)		175(38.2)
Pattern of anal intercourse in the past year			0.051	
Mainly receptive	155(61.3)	107(52.2)		262(57.2)
Mainly insertive	98(38.7)	98(47.8)		196(42.8)
Number of male sexual partners in the past six months	3(2–4)	3(2–5)	0.830	3(2–5)
Frequency of condom use during sex with other men in the past six months			0.072	
Never	12(4.7)	17(8.3)		29(6.3)
Sometimes	96(38.0)	60(29.3)		156(34.1)
Always	145(57.3)	128(62.4)		273(59.6)
Experience of commercial sex in the past six months			0.014	
Yes	15 (5.9)	3(1.5)		18(3.9)
No	238(94.1)	202(98.5)		440(96.1)
Experience of sex with women in the past six months			0.000	
Yes	55 (21.7)	10 (4.9)		65(14.2)
No	198(78.3)	195(95.1)		393(85.8)
Voluntary HIV counseling and testing			0.000	
Yes	213(84.2)	203(99.0)		416(90.8)
No	40(15.8)	2(1.0)		42(9.2)
Circumcision			0.151	
Yes	104(41.1)	98(47.8)		202(47.8)
No	149(58.9)	107(52.2)		256(55.9)
Hepatitis B vaccination			0.001	
Yes	105(41.5)	84(41.0)		189(41.3)
No	124(49.0)	118(57.6)		242(52.8)
Unclear	24(9.5)	3(1.5)		27(5.9)
Ever had STDs in the past year			0.125	
Yes	20(7.9)	25(12.2)		45(9.8)
No	233(92.1)	180(87.8)		413(90.2)

Table 3. Awareness and knowledge of HPV among 458 MSM in Urumqi, China.

Knowledge on HPV	ALL	HIV(-)	HIV(+)	P value
	n (%)	n (%)	n (%)	
Ever heard of HPV				0.227
Yes	218(47.6)	114(45.1)	104(50.7)	
No	240(52.4)	139(54.9)	101(49.3)	
Of those who responded Yes above				0.144
Males could be affected by HPV				
Yes [#]	213(97.7)	113(99.1)	100(96.2)	
No/Uncertain	5(2.3)	1(0.9)	4(3.8)	
HPV is transmitted through skin to skin contact				0.860
Yes [#]	148(67.9)	78(68.4)	70(67.3)	
No/Uncertain	70(32.1)	36(31.6)	34(32.7)	
HPV is sexually transmitted				0.359
Yes [#]	214(98.2)	111(97.4)	103(99.0)	
No/Uncertain	4(1.8)	3(2.6)	1 (1.0)	
HPV is a virus that can cause genital warts				0.000
Yes [#]	88(40.4)	68(59.6)	20(19.2)	
No/Uncertain	130(59.6)	46(40.4)	84(80.8)	
HPV is a virus that can cause cancer				0.009
Yes [#]	179(82.1)	101(88.6)	78(75.0)	
No/Uncertain	39(17.9)	13 (11.4)	26(25.0)	

Notes: HIV (-) denotes HIV-uninfected MSM whereas HIV (+) denotes HIV-infected MSM.

The option with the [#] symbol is the correct response.

Table 4. Intention to receive HPV vaccination among 458 MSM in Urumqi, China.

Intention to receive HPV vaccination	HIV(-)	HIV(+)	P value	ALL
	n(%)/median (IQR)	n(%)/median (IQR)		n(%)/median (IQR)
Willing to receive HPV vaccination for free			< 0.001	
Yes	240(94.9)	203(99.0)		443(96.7)
No	13(5.1)	2(1.0)		15(3.3)
Willing to pay to receive vaccination			< 0.001	
Yes	164(64.8)	165(80.5)		329(71.8)
No	89(35.2)	40(19.5)		129(28.2)
How much would you pay for the HPV vaccination (RMB)?	200(100–300)	200(100–425)	0.335	200(100–350)

Predictors of willingness to pay for HPV vaccine

The results of the univariate and multivariate logistic regression analyses deployed to evaluate the associations between other survey variables and the willingness to pay for HPV vaccination, are shown in Table 5. Multivariate logistic regression analysis indicated that among the studied MSM population their local residency (OR: 2.45, 95%CI: 1.47–4.07), employment status (OR: 1.95, 95%CI: 1.02–3.73), hepatitis B vaccination status (OR: 0.33, 95%CI: 0.12–0.84), HPV awareness (OR: 2.61, 95%CI: 1.60–4.28) and HIV status (OR: 0.54, 95%CI: 0.32–0.90) were independent predictors of the willingness to pay for HPV vaccination.

Discussion

The current data showed that a large proportion of the MSM who took part in the current survey (57.2% of total, Table 2), commonly engage to high-risk sexual behaviors such as receptive intercourse, which is a well-documented risk factor for HPV infection.²⁷ Interestingly, this study revealed that around a fifth (18.6%) of the MSM population investigated was married (i.e. to women since in China only heterosexual marriage is currently legally allowed); a proportion that is considerably higher than in previous research.²⁸ This finding further demonstrates that enhancing HPV knowledge and prevention of HPV infection in this high-risk group in Urumqi and more generally in China is of paramount importance in order to prevent HPV transmission to the female partners of the significant portion of MSM who are married. As such it is of critical importance to recommend HPV vaccination of high-risk MSM in order to decrease the prevalence of HPV among this population. In-depth understanding of HPV knowledge and HPV vaccination acceptability among local MSM will form the basis on which a local government can formulate informed and effective vaccination promotion strategies in the near future. In the current study, HPV knowledge among 458 MSM was investigated, in participants who did not receive information or explanations regarding HPV prior to completing the survey. The current results suggest that the MSM population in Urumqi, China has poor knowledge of HPV, at levels relatively lower than expected compared to global data previously reported in a 2014 systematic review and

Table 5. Univariate and multivariate logistic regression analysis of risk factors for intention to receive HPV vaccination in 458 MSM in Urumqi, China.

Characteristics	N	COR (95%CI)	P value	AOR (95%CI)	P value
Local residency					
Yes	347	Ref.		Ref.	
No	111	2.50 (1.59–3.92)	< 0.001	2.45 (1.47–4.07)	0.001
Ethnic group					
Han	355	Ref.			
Others	103	1.60 (1.00–2.56)	0.048		
Employment status					
Employed	402	Ref.		Ref.	
Not employed	56	2.12 (1.19–3.76)	0.010	1.95 (1.02–3.73)	0.043
Self-reported sexual orientation					
Gay	435	Ref.			
Bisexual/ heterosexual*	23	4.23 (1.82–10.27)	0.001		
Gender of sex partner					
With men only	283	Ref.			
Both men and women	175	1.84 (1.22–2.79)	0.004		
Frequency of condom use during sex with other men in the past six months					
Never	29	Ref.	0.045		
Sometimes	156	1.29 (0.53–3.15)	0.571		
Always	273	0.75 (0.31–1.79)	0.517		
Experience of commercial sex in the past six months					
Yes	18	Ref.			
No	440	0.47 (0.18–1.23)	0.125		
Experience of sex with women in the past six months					
Yes	65	Ref.			
No	393	0.39 (0.23–0.70)	0.001		
Engaging in voluntary HIV counseling and testing					
Yes	416	Ref.			
No	42	2.85 (1.49–5.42)	0.001		
Hepatitis B vaccination					
Yes	189	Ref.	< 0.001	Ref.	< 0.001
No	242	0.33 (0.21–0.52)	< 0.001	0.90 (0.36–2.28)	0.837
Unclear	27	1.71 (0.76–3.84)	0.193	0.33 (0.12–0.84)	0.020
Ever heard of HPV					
Yes	218	Ref.		Ref.	
No	240	3.19 (2.05–4.97)	< 0.001	2.61 (1.60–4.28)	< 0.001
HIV diagnosis					
Uninfected	253	Ref.		Ref.	
Infected	205	0.44 (0.29–0.68)	0.000	0.54 (0.32–0.90)	0.019

Notes: Univariately non-significant variables were not listed in this table; COR: crude odds ratio; AOR: adjusted OR, 95% CI: 95% confidence interval. * Men who identify themselves as heterosexual but defined as MSM due to reporting having anal and/or oral sex with other men in the last 12 months prior to participation in the study. Ethnic group, Self-reported sexual orientation, Gender of sex partner, Experience of sex with women in the past six months, Engaging in voluntary HIV counseling and testing were adjusted for calculated AOR.

other studies conducted out of China.^{22,29} Although the proportion of individuals who were aware of HPV is higher among HIV-infected MSM than that of HIV-uninfected, among those who knew about HPV, HIV-uninfected had a greater correct responses rate to further survey items than HIV-infected individuals. More generally the findings of these study clearly indicate that improvement of HPV knowledge of transmission, risk factors and prevention among MSM especially high-risk MSM in Urumqi.

Furthermore, most participants in the current study were highly educated and as such it is presumed that their HPV awareness could potentially be significantly higher than that of a less educated MSM cohort, which in turn suggests that the real-life HPV awareness in Urumqi MSM may be lower than that observed in the current study population. In China, there is a significant correlation between local residency and social status,³⁰ with an individual being considered of a higher social status if they are a local resident. Local residents refer to those born in Urumqi, and registered in the Urumqi (who have registry status with the local “hukou”), nonlocal residents

refer to those born in other cities. Most non-local residents were come from small city or rural areas where are less developed, they came to Urumqi for making money, or attending college. The majority of MSM in the current survey were local residents and their willingness to pay for HPV vaccine, could be attributed to the relatively higher social status that compared to non-local residents. Along with the higher social status these individuals are more likely to have more access to social resources, HPV related information and are more conscious about their health; this is supported by evidence indicating that migrants have a higher risk of STIs and hepatitis than the general Chinese population.³¹ Therefore, when promoting HPV vaccination programs, it would be easier to begin with local residents who are already more receptive to the idea of receiving HPV vaccine and then gradually engage with non-local residents who will require more education and longer time to engage with the programs. At the same time, in order to ensure a higher coverage rate of vaccines, for non-local residents, it is appropriate to implement HPV knowledge promotion strategies firstly to enhance

their HPV knowledge. As shown in the current study employment status is also significantly associated with acceptability of HPV vaccination. In China unemployed people receive relatively little assistance from the state which might explain the lack of willingness to accept HPV vaccination either because healthcare is sidetracked by other everyday needs or because of the perceived costs of HPV vaccination and their inability to personally cover the cost.

The demonstrated lack of appropriate knowledge of HPV infection may potentially influence the population's perception of the need to adopt preventive behaviors which are often influenced by the perceived susceptibility and severity of a condition. The findings and exposed weaknesses indicated by the current research could provide the focus points for targeted future improvements in HPV awareness. To promote the newly available HPV vaccines among MSM, it is essential to increase the populations awareness and understanding of HPV; this could be done through a variety or combination of means such as Internet, social media, multimedia and NGO promotions as well as in school health education workshops targeted to both students and school staff and face-to-face HPV education intervention sessions both for healthcare staff and patients. This will make it easier for MSM to obtain the correct knowledge of HPV and improve vaccine acceptability, whilst promoting the issue to the general public. Despite limited knowledge of HPV among the total MSM cohort, the majority of MSM were willing to accept HPV vaccination when assumed this would be provided free of charge by a healthcare provider. The current data show that the percentage of the MSM population willing to pay to receive HPV vaccination (proposed cost not disclosed to participants) was higher than previous studies where the cost of HPV vaccination was disclosed to participants.^{21,32–34} This indicates that the cost of the HPV vaccination could be a potentially great impediment to the MSM population's willingness to be vaccinated for HPV. All HPV vaccines are currently charged in China, therefore, the willingness of the interviewed MSM population to pay for the vaccine is a meaningful reflection of the applicability of the data in real life.³⁵ The observed significantly increased willingness to pay for HPV vaccination in the HIV-infected MSM compared to HIV-uninfected MSM population in the current study might be due to differences in risk consciousness; HIV-infected MSM may pay more attention to their health conditions and may think they have higher risk of HPV infection and as such are willing to pay to receive HPV vaccination. Previous findings have shown that individuals who are more aware of potential risks to their health are more likely to engage in self-protective behaviors.³⁶ More tellingly, other studies have shown that assessments of HPV infection risk and awareness of HPV were contributing factors to the acceptability of HPV vaccination.^{36,37} The currently licensed HPV vaccines are likely to be effective in HIV-infected individuals³⁸ thus their utilization in the HIV-infected MSM population demonstrating higher willingness to receive HPV vaccination could be imminent once government approval has been granted. Collectively the evidence suggests that the local government should carefully consider recommending HPV vaccination for all MSM, but

especially for HIV-infected MSM. HIV clinics are concentrated large number of HIV-infected MSM could be targeted would be a good starting point for promoting HPV knowledge and HPV immunization programs.

To promote HPV vaccination among MSM effectively, it is critical to understand the factors that influence the willingness to pay for HPV vaccine. In the current study it was concluded that at least five variables investigated (local residency, employment status, hepatitis B vaccination, awareness of HPV and HIV status) were all significantly associated with acceptability of HPV vaccination. The current findings indicating that MSM who were aware of HPV were more likely to pay for HPV vaccination than those who had never heard of HPV, are in agreement with previous results from a study conducted in Canada,³⁹ this study included 1169 MSM, among them, 67.0% were willing to receive HPV vaccine and 71.3% had heard of HPV, and indicated that HPV vaccines acceptability varied by demographics, risk, and HPV awareness.

Besides, in addition to improving MSM's HPV related knowledge, reducing risky sexual behavior is also an important aspect of reducing HPV transmission and infection. A large proportion of MSM in the current study was married to women, signaling the importance of taking action to reduce HPV transmission between MSM and also women. Examples of how this can be done include further education MSM regarding the use of condoms when engaging in sex with both sexes and by engaging eligible female partners in receiving HPV vaccine. At present, China's HPV immunizations on offer are still relatively expensive (about 5800RMB) and starkly different to the average cost of 200RMB for the HPV vaccine the study participants were willing to pay. It can be suggested that reducing the cost of HPV vaccination substantially would play a critical role in increasing HPV immunization coverage for both MSM and females. At present, experts in China have been conducting Randomized clinical trials (RCTs) for domestic HPV vaccines; If the results are favorable and the after the domestic vaccines successfully marketed in China, the price of HPV vaccines could be greatly reduced, thus the government could promote a policy that government will pay for HPV vaccines, as the authority already covered HIV treatment for all clinics. All these would significantly enhancing HPV immunization coverage.

It is acknowledged that some limitations in the study design may have affected the observed outcomes. Firstly, participant selection bias cannot be excluded since we used non-probability convenience sample in the current study and MSM were only recruited from two sites where a large proportion of the participants (81%) had reported having a university degree.; As such the study population would only represent views of a highly educated sub-group of MSM. In fact, at the sites involved in the participant recruitment in the current study, it has been observed that less-educated MSM generally do not routinely engage in HIV counseling and testing, and thus the results of the current study cannot be generalized to the wider MSM population. Secondly, there is a chance of self-reported bias; For instance, since the survey administered questions on potentially sensitive sexual behaviors, it is possible that some perceived positive behaviors (e.g.

frequency of condom use) were exaggerated whilst some perceived negative behaviors (e.g. number of sexual partners) were underestimated by participants in an attempt to be viewed more favorably by the assessors. Thirdly, no information was collected from HIV-infected MSM in regard to receiving antiretroviral therapy (ART), adherence and virological suppression, therefore, any bias these parameters may confer on the study results cannot be excluded. However, since the HIV-infected MSM we recruited from a single HIV clinic, where ART is routinely provided, it could be suggested that HIV-infected MSM in the current study were probably on ART but still adherence and viral load suppression remain unknown. Lastly, as specified earlier refusal to participate was not monitored, as such the population recruited in the study could have had a increased interest in HPV and extent resulting to an overestimation of HPV acceptance among the general population.

Conclusions

In summary, the participants in the current study had overall poor knowledge of HPV nonetheless after a consultation the majority of MSM surveyed were willing to accept HPV vaccination, with HIV-infected individual having a dramatically higher acceptability rate of HPV vaccination than HIV-uninfected MSM. Furthermore, participating MSM who had some previous awareness of HPV were more likely to pay for HPV vaccination. Collectively these results illustrate that future promotion of HPV vaccination should also focus on the promotion of HPV-related knowledge, while paying close attention to HIV-infected MSM.

Materials and methods

Study population

A cross-sectional survey was performed between January 1st and April 30th 2017, to investigate HPV vaccination acceptability among HIV-uninfected and HIV-infected MSM in Urumqi, China. Participants were recruited through convenience sampling from two sites: HIV-uninfected MSM ($n = 253$) through a local NGO (Tian'Shan Volunteers Workstation) and HIV-infected MSM ($n = 205$) through a HIV outpatient clinic (Infectious Diseases Hospital of Xinjiang). For the purposes of the current research, MSM was defined as men who had anal and/or oral sex with other men in the last 12 months prior to participation in the study, including men who identified themselves as heterosexual. Potential MSM participants were eligible if they were 18 years or older and willing to consent to taking part in the current study. Refusal to participate in the study was not recorded. In order to confirm the HIV status of participants recruited through the NGO site, 8 ml venous blood was collected and their HIV infection status was initially determined by an enzyme immunoassay (4 ml venous blood, Wantai Biological Pharmacy, Beijing, China) and subsequently confirmed by HIV-1/2 Western blot assay (4 ml venous blood, HIV Blot 2.2 WB; Genelabs Diagnostics, Singapore). The results confirmed that all of the participants

recruited through the NGO site were HIV-uninfected. All recruited MSM completed a study survey (the average completion time was 10 min) in a private consultation room. All participants were compensated with 30 RMB (approximately four and half US dollars) for their time.

Data collection

The self-administered survey including a series of single item questions was designed by the research team and was based on previously published studies examining HPV vaccine acceptability in MSM.^{21, 32, 33, 40} The experts selected items that they thought could reflect HPV knowledge and vaccination intentions based on literature and experience. The survey was piloted among 25 participants prior to implementation. Information on socio-demographic characteristics such as age, marital status, residency location, income and education were collected. Firstly, HPV awareness was assessed (i.e. survey question item "Ever heard of HPV"). Once awareness was established further survey questions were asked (see Table 3) to decipher the extend of the participants' HPV relevant knowledge. Only the ones who said they were aware of HPV were included in the later survey questions that asked about HPV knowledge. Secondly, the acceptability of HPV vaccination among MSM was assessed by the following survey question items (see Table 4): 1) Willing to receive HPV vaccination for free; 2) Willing to pay for receiving vaccination; and 3) How much would you pay for the HPV vaccination (RMB) (a continuous variable and participants could write in any amount).

Statistical analysis

SPSS version 17.0 (SPSS Inc., Chicago, IL, USA) was utilized for the statistical analysis. Basic demographics were reported as totals and percentages. Comparisons between the two groups were performed through chi-squared tests. A univariate logistic regression model was developed to evaluate associations between each variable under investigation and their willingness to pay for HPV vaccination. All variables in the univariate analysis which yielded p -values < 0.05 were entered into a multivariate logistic regression model to determine any independent predictors of the willingness to pay for HPV vaccination. Crude odds ratios (COR) and adjusted odds ratios (AOR) were calculated along with 95% confidence intervals (CIs).

Disclosure of potential conflicts of interest

No potential conflict of interest was reported by the authors.

Acknowledgments

This work was supported by the Natural Science Foundation of China (81560539). The funder had no input in the study design, data collection and analysis, the decision to publish, or the preparation of the manuscript. The authors thank the volunteers from Tian'Shan Volunteers Workstation for their great efforts in recruiting the study participants.

Ethics approval

The present study was reviewed and approved by the Xinjiang Medical University First Affiliated Hospital Ethics Committee (No.:20160512-11). Before the study interviews, each participant signed an informed consent.

Funding

This work was supported by the National Natural Science Foundation of China [81560539].

Notes on contributor

DJ designed and coordinated the study, TT collected the data, did the statistical analysis, interpreted the findings and prepared the manuscript. DW helped design the study, analyze the data and to prepare the manuscript. CP contributed to result interpretation and manuscript writing. ZY and HB helped design the study. SG and ZZ recruited the study volunteers. YM and TX helped design the study and interpret the data and performed statistical analysis. GZ designed and coordinated the study and interpreted the data.

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